the application in condition for allowance in view of the art of record. On behalf of Mr. DePardo, the undersigned would like to thank Examiner Lavarias for the courtesy and cooperation extended during that interview.

In light of the aforementioned remarks, please amend the above-identified application as follows:

IN THE SPECIFICATION

Please amend the specification, as follows:

Page 1, Lines 7-12

--This application claims the benefit of US Provisional Patent Application, Serial No. 60/410,541 ~~(CiDRA Docket No. CC-543)~~, filed Sept. 12, 2002, and is a continuation-in-part of US Patent Application, Serial No. 10/645,689 ~~(CiDRA Docket No. CC-0648)~~, filed Aug. 20, 2003, and is a continuation-in-part of US Patent Application, Serial No. 10/645,686 ~~(CiDRA Docket No. CC-0649)~~, filed Aug. 20, 2003, each of which are incorporated herein by reference in their entirety.--

Page 1, Lines 14-17

--US Patent Applications Serial No. 10/661,234 ~~(CiDRA Docket No. CC-0648A)~~, Serial No. 10/661,031 ~~(CiDRA Docket No. CC-0649A)~~, and Serial No. 10/661,254 ~~(CiDRA Docket No. CC-0653)~~, all filed contemporaneously herewith, contain subject matter related to that disclosed herein, which are all incorporated by reference in their entirety.--

Page 2, Lines 13-19

--According to a first aspect of the present invention, an optical identification element for identifying an item, comprises a substrate having at least one diffraction grating disposed therein, said grating having a resultant refractive variation at a grating location, the grating being embedded within a substantially single material of said substrate; and the grating providing an output optical signal indicative of a code when illuminated by an incident light signal propagating in free space, the code identifying at least one of the element and the item, the output signal being a result of passive, non-resonant scattering from the grating when illuminated by the incident light signal ~~an optical substrate; at least a portion of the substrate having at least one diffraction grating disposed therein, the grating having at least one refractive index pitch superimposed at a common location; the grating providing an output optical signal when illuminated by an incident light signal; the optical output signal being indicative of a code~~; and the element being at least partially disposed on the item.--

Page 2, Lines 20-25

--According to a second aspect of the present invention, a method of reading a code associated with an optical identification element that is disposed on an item, the element having a diffraction grating having a resultant refractive index variation at a grating location, the grating being embedded within a substantially single material of said substrate, comprising: illuminating the element with incident light propagating in free space, the code identifying at least one of the element and the item, the grating providing an output light signal indicative of the code, the output signal being a result of passive, non-resonant scattering with the grating when illuminated by the incident light signal; ~~in an~~

~~optical identification element that is disposed on an item, the element having a diffraction grating with one or more refractive index pitches superimposed at a common location, comprises: illuminating the element with incident light, the substrate providing an output light signal;~~ and reading the output light signal and detecting a code therefrom.--

Page 7, Lines 10-13

--The optical identification element described herein is the same as that described in Copending Patent Application Serial No. 10/661,234 ~~(CiDRA Docket No. CC-0648A)~~, filed contemporaneously herewith, which is incorporated herein by reference in its entirety.--

Page 9, Lines 1-3

--The grating 12 may have a length Lg of about the length L of the substrate 10. Alternatively, the length Lg of the grating 12 may be shorter than the total length L of the substrate 10, as shown in Fig. 1 ~~11~~.--

Page 12, Lines 22-27

--The elements 8 can be placed in a fluid or powder and the fluid or powder is used for labeling an item. For example, the elements 8 may be mixed with paint (or other adhesive fluid) and sprayed on an item, such as a car or boat (see Fig. 7, illustrations (b) and (c)) or any other item that can be sprayed or

painted. The same may be done with a dry powder that is sprayed on a newly painted or otherwise adhesive surface, or with an adhesive powder that is sprayed on a dry, or painted or adhesive surface.--

Page 13, Lines 11-13

--Referring to Fig. 7, ~~illustration~~ illustrations (i) and (j), the elements 8 may be used to label plants 847 and food containers 848 ~~847~~ and the like.--

Page 14, Lines 9-19

--In particular, there may be start and stop bits 869, 871, respectively. The start and stop bits may each take up more than one bit location if desired. In addition there may be an error check portion of the message, such as a check sum or CRC (cyclic redundancy check) having a predetermined number of bits, and a code section 873 having a predetermined number of bits. The error check portion ensures that the code which is obtained from the bead is accurate. Accordingly, having a large number of bits in the element 8 allows for greater statistical accuracy in the code readout and decreases the likelihood of providing an erroneous code. Accordingly, if a code cannot be read without an error, no code will be provided, avoiding an erroneous result. Any known techniques for digital error checking for single or multi-bit errors may be used.--

Page 15, Line 9

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Page 15, Lines 10-18

--Referring to Fig. 9, the ~~The~~ reflected light 27, comprises a plurality of beams 26-36 that pass through a lens 37, which provides focused light beams 46-56, respectively, which are imaged onto a CCD camera 60. The lens 37 and the camera 60, and any other necessary electronics or optics for performing the functions described herein, make up the reader 29. Instead of or in addition to the lens 37, other imaging optics may be used to provide the desired characteristics of the optical image/signal onto the camera 60 (e.g., spots, lines, circles, ovals, etc.), depending on the shape of the substrate 10 and input optical signals. Also, instead of a CCD camera other devices may be used to read/capture the output light.--

Page 18, Line 26, Page 19, Line 3

--Referring to Fig. 12, illustrations (a)-(c), for the grating 12 in a cylindrical substrate 10 having a sample spectral 17 bit code (i.e., 17 different pitches $\Lambda 1$-$\Lambda 17$), the corresponding image on the CCD (Charge Coupled Device) camera 60 is shown for a digital pattern of 17 bit locations 89, including Figure 12, illustrations (b), (c) and (d), respectively, 7 bits turned on (10110010001001001); 9 bits turned on of (11000101010100111); and all 17 bits turned on of (11111111111111111).--

Page 21, Lines 15-28

--In Fig. 14, the bits may be detected by continuously scanning the input wavelength. A known optical source 300 provides the input light signal 24 of a coherent scanned wavelength input light shown as a graph 304. The source 300 provides a sync signal on a line 306 to a known reader 308. The sync signal may be a timed pulse or a voltage ramped signal, which is indicative of the wavelength being provided as the input light 24 to the substrate 10 at any given time. The reader 308 may be a photodiode, CCD camera, or other optical detection device that detects when an optical signal is present and provides an output signal on a line 309 indicative of the code in the substrate 10 or of the wavelengths present in the output light, which is directly related to the code, as discussed herein. The grating 12 reflects the input light 24 and provides an output light signal 310 to the reader 308. The wavelength of the input signal is set such that the reflected output light 310 through an optical lens 321 will be substantially in the center 314 of the Bragg envelope 200 for the individual grating pitch (or bit) being read.--

Page 23, Lines 14-19

--In this case, rather than having the input light 24 coming in at the conventional Bragg input angle $\theta i$, as discussed hereinbefore and indicated by a dashed line 701, the grating 12 is illuminated with the input light 24 oriented on a line 705 orthogonal to the longitudinal grating vector 703 ~~705~~. The input beam 24 will split into two (or more) beams of equal amplitude, where the exit angle $\theta_o$

can be determined from Eq. 1 with the input angle $\theta_i=0$ (normal to the longitudinal axis of the grating 12).--

Page 23, Lines 20-26

--In particular, from Eq. 1, for a given grating pitch $\Lambda 1$, the +/-1$^{st}$ order beams (m=+1 and m=-1), corresponds to output beams 700,702, respectively. For the +/-2$^{nd}$ order beams (m=+2 and m=-2), corresponds to output beams 704,706, respectively. The 0$^{th}$ order (undiffracted) ~~(undefracted)~~ beam (m=0), corresponds to beam 708 and passes straight through the substrate. The output beams 700-708 project spectral spots or peaks 710-718, respectively, along a common plane, shown from the side by a line 709, which is parallel to the upper surface of the substrate 10. --

Page 24, Lines 9-17

--Referring to Fig. 17, if two pitches $\Lambda 1, \Lambda 2$ exist in the grating 12, two sets of peaks will exist. In particular, for a second grating pitch $\Lambda 2$, the +/-1$^{st}$ order beams (m=+1 and m=-1), corresponds to output beams 720,722, respectively. For the +/-2$^{nd}$ order beams (m=+2 and m=-2), corresponds to output beams 724,726, respectively. The 0$^{th}$ order (undiffracted) ~~(un-defracted)~~ beam (m=0), corresponds to beam 718 and passes straight through the substrate. The output beams 720-726 corresponding to the second pitch $\Lambda 2$ project spectral spots or peaks 730-736, respectively, which are at a different location than the point 710-716, but along the same common plane, shown from the side by the line 709.--

Page 24, Line 23, to Page 25, Line 5

--In general, if the angle of the grating 12 is not properly aligned with respect to the mechanical longitudinal axis of the substrate 10, the readout angles may no longer be symmetric, leading to possible difficulties in readout. With a thin grating, the angular sensitivity to the alignment of the longitudinal axis of the substrate 10 to the input angle $\theta i$ of incident radiation is reduced or eliminated. In particular, the input light can be oriented along substantially any angle $\theta i$ with respect to the grating 12 without causing output signal degradation, due to the large Bragg angle envelope. Also, if the incident beam 24 is normal to the substrate 10, the grating 12 can be oriented at any rotational (or azimuthal) angle without causing output signal degradation. However, in each of these cases,

changing the incident angle θi will affect the output angle θo of the reflected light in a predetermined predictable way, thereby allowing for accurate output code signal detection or compensation.--

Page 26, Lines 15-28

--Referring to Fig. 20, instead of using an optical binary (0-1) code, an additional level of multiplexing may be provided by having the optical code use other numerical bases, if intensity levels of each bit are used to indicate code information. This could be achieved by having a corresponding magnitude (or strength) of the refractive index change (δn) for each grating pitch Λ. Four intensity ranges are shown for each bit number or pitch Λ, providing for a Base-4 code (where each bit corresponds to 0,1,2, or 3). The lowest intensity level, corresponding to a 0, would exist when this pitch Λ is not present in the grating 12. The next intensity level 450 would occur when a first low level δn1 exists in the grating that provides an output signal within the intensity range corresponding to a 1. The next intensity level 452 would occur when a second higher level δn2 exists in the grating 12 that provides an output signal within the intensity range corresponding to a 2. The next intensity level 454 ~~452~~, would occur when a third higher level δn3 exists in the grating 12 that provides an output signal within the intensity range corresponding to a 3.--

Page 28, Lines 14-27

--Referring to Fig. 22, if the value of n1 in the grating region 20 is greater than the value of n2 in the non-grating region 18, the grating region 20 of the substrate 10 will act as a known optical waveguide for certain wavelengths. In that case, the grating region 20 acts as a "core" along which light is guided and the outer region 18 acts as a "cladding" which helps confine or guide the light. Also, such a waveguide will have a known "numerical aperture" (θna) that will allow light 630 that is within the aperture θna to be directed or guided along the grating axis 207 and reflected axially off the grating 12 and returned and guided along the waveguide. In that case, the grating 12 will reflect light having the appropriate wavelengths equal to the pitches Λ present in the grating 12 back along the region 20 (or core) of the waveguide, and pass the remaining wavelengths of light as the light 632. Thus, having the grating region 20 act as an optical waveguide for wavelengths reflected by the grating 12 allows incident light that is not aligned exactly with the grating axis 207 to be guided along and aligned with the grating 12 axis 207 for optimal grating reflection.--

Page 33, line 17, to Page 34, Line 6

--Referring to Fig. 32, illustrations (a), (b), (c), (d), and (e) the substrate 10 may have one or more holes located within the substrate 10. In illustration (a), holes 560 may be located at various points along all or a portion of the length of the substrate 10. The holes need not pass all the way through the substrate 10. Any number, size and spacing for the holes 560 may be used if desired. In

illustration (b), holes 572 may be located very close together to form a honeycomb-like area of all or a portion of the cross-section. In illustration (c), one (or more) inner hole 566 may be located in the center of the substrate 10 or anywhere inside of where the grating region(s) 20 are located. The inner hole 566 may be coated with a reflective coating 573 to reflect light to facilitate reading of one or more of the gratings 12 and/or to reflect light diffracted off one or more of the gratings 12. The incident light 24 may reflect off the grating 12 in the region 20 and then reflect off the surface 573 to provide output light 577. Alternatively, the incident light 24 may reflect off the surface 573, then reflect off the grating 12 and provide the output light 575. In that case the grating region 20 may run axially or circumferentially 571 around the substrate 10. In illustration (d), the holes 579 may be located circumferentially around the grating region 20 or transversely across the substrate 10. In illustration (e), the grating 12 may be located circumferentially around the outside of the substrate 10, and there may be holes 574 inside the substrate 10. <u>In that case, the incident light 24 reflects off the grating 12 to provide the optical light 576.</u>--

<u>Page 34, Lines 11-19</u>

--Referring to Fig. 34, illustrations (a), (b), (c) a D-shaped substrate, a flat-sided substrate and an eye-shaped (or clam-shell or teardrop shaped) substrate 10, respectively, are shown. Also, the grating region 20 may have end cross-sectional shapes other than circular and may have side cross-sectional shapes other than rectangular, such as any of the geometries described herein for the substrate 10.

For example, the grating region 20 may have an ~~a~~ oval cross-sectional shape as shown by dashed lines 581, which may be oriented in a desired direction, consistent with the teachings herein. Any other geometries for the substrate 10 or the grating region 20 may be used if desired, as described herein.--

Page 34, Lines 20-22

--Referring to Fig. 35, at least a portion of a side of the substrate 10 may be coated with a reflective coating 514 to allow incident light 510 to be reflected back to the same side from which the incident light came, as indicated by reflected light 512.--

Page 34, Line 23, to Page 35, Line 4

--Referring to Fig. 36, illustrations (a) and (b), alternatively, the substrate 10 can be electrically and/or magnetically polarized, by a dopant or coating, which may be used to ease handling and/or alignment or orientation of the substrate 10 and/or the grating 12, or used for other purposes. Alternatively, the bead may be coated with conductive material, e.g., metal coating on the inside of a holey ~~holy~~ substrate, or metallic dopant inside the substrate. In these cases, such materials can cause the substrate 10 to align in an electric or magnetic field. Alternatively, the substrate can be doped with an element or compound that fluoresces or glows under appropriate illumination, e.g., a rare earth dopant, such as Erbium, or other rare earth dopant or fluorescent or luminescent molecule. In

that case, such fluorescence or luminescence may aid in locating and/or aligning substrates.--